

Growth and yield of lentil (*Lens culinaris* L.) as affected by Boron and Molybdenum application in lateritic soil.

A. CHAKRABORTY

Regional Research Substation, Red and Laterite zone,
Bidhan Chandra Krishi Viswavidyalaya, Sekhampur, Birbhum,

ABSTRACT

Field experiments were conducted during winter seasons of 2004-05 and 2005-06 at the RRSS, Sekhampur, BCKV, to study the effect of B and Mo to the growth, and yield of lentil grown on inherently poor lateritic soil. The lentil (cv. B77) was raised with application of B and Mo either separately or in mixture through foliage or to soil along with NPK fertilizers. The leaf area index, above ground dry matter and crop growth rate increased with the application of B and Mo. Soil application of B coupled with foliar application of Mo enhanced the yield attributing characters and yield of the lentil crop. The study indicated that growing of lentil in lateritic soils depleted the nutrients particularly micronutrients which resulted in loss of yield and could be recovered, if the relevant micronutrients are supplemented through appropriate application methods and dosage.

Key words: Boron, CGR, molybdenum and LAI.

Lentil (*Lens culinaris* L.) is one of the commonly grown pulse crops in India. Pulse crops are generally grown in marginal and poorly fertile soils, almost exclusively under rain-fed condition without proper management practices. Among the major constraints affecting the production of pulses, lack of proper management practices assumes importance on account of continuous depletion of micronutrients due to over mining by way of intensive cropping and continuous application of major (NPK) nutrients only (Fageria *et al.*, 2002). Mo is an essential component of nitrogenase and B is essential for the formation of nodules on legume roots (Yanni, 1992). It is, therefore, impending to include micronutrients in fertilization schedules for dry land lateritic tracts (Singh, 2001). Increases in seed yield of pulses from application of micronutrients are reported (Okaz, 1994; Singh, 2001) but the lentil crop has so far received scanty attention. In view of the limited information, this experiment was designed to ascertain the response of lentil crop to application of B and Mo.

MATERIALS AND METHODS

Field experiments were carried out at the RRSS, Sekhampur, Birbhum, Red and Laterite zone, Bidhan Chandra Krishi Viswavidyalaya during two successive winter seasons of 2004- 05 and 2005-06 to study the soil and foliar applications of B and Mo on growth, yield attributing characters and yield of lentil (cv. B77). The physico-chemical properties of the experimental soil are presented in table 1. The experiment consisted of seven treatments *i.e* T₁:control (no input); T₂ : 20:40:20 kg/ha NPK, T₃: T₂ + B (10 kg/ha borax) + Mo (1.5 kg/ha) ; T₄:T₂ + B (10 kg/ha) + Mo (0.2% as foliar at 45 and 65 DAS); T₅ :T₂ + B (10 kg/ha); T₆: T₂ + Mo (1.5 kg/ha); and T₇

:T₂ + Mo (0.2% as foliar at 45 and 65 DAS).The sources of N,P,K, B and Mo were urea, single superphosphate, muriatic of potash, borax and ammonium molybdate respectively. The experiment was laid out in a randomized block design with three replications. The seeds were sown on 2nd December 2004 and 5th December 2005 with a seed rate of 16 kg/ha with a spacing 30 x 10 cm in 5 x 4 m plots. Crop management practices were done as per schedule and necessity.

Representative plant samples were collected at 20, 40, 60, 90 and 120 (at harvest) DAS. The above ground portions were oven dried at 80^o C for 48 h for dry weight. The CGR was calculated following the method of Brown (1984). The leaf area at 90 DAS was measured using leaf area meter and the LAI was calculated. Three plants from each plot were uprooted carefully at 70 DAS. The root nodules were counted and then oven dried at 50^o C for 5 days to record the dry weights. Random samples from 10 plants, leaving two border rows, were taken from each plot at harvest and the plant height, number of pods/plant, 1000-seeds weight and seed yield were measured. Data were analyzed using SPSS (10.0.1 version) statistical software and the treatment means were compared by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

The above ground dry matter (AGDM) accumulated slowly up to 40 DAS and then rapidly till maturity (Fig 1). The T₄ treatment recorded higher dry matter than the other treatments. During the maximum dry matter accumulation at 120 DAS, the treatments in which B and Mo were used either singly or in combination applied to soil or foliage recorded statistically similar values that of the exclusive NPK

fertilizers (T₂) treatment. A marginal increase in dry matter could be observed in the T₆ treatment (13.18 g/plant) where Mo was applied foliarly than the soil application (T₇, 12.67 g/plant). In general, irrespective of the treatments, the peak CGR occurred during 60-90 DAS corresponding to the pod development stage of lentil (Fig. 2). The maximum CGR at 60-90 DAS was registered with T₄ treatment (0.25 g/plant/day) although not statistically different from treatments - T₅ (0.186 g/plant/day), T₃ (0.182 g/plant/day), T₇ (0.180 g/plant/day) and T₆ (0.179 g/plant/day). However, the exclusive NPK fertilizers treatment (T₂) although showed lower CGR values, but statistically similar to the treatments T₃, T₆ and T₇. Increased CGR in the treatments inclusive of B and Mo is indicative of enhanced physiological growth condition of a crop which enables to produce higher seed yield (Karim and Fattah, 2007). A linear relationship ($R^2 = 0.807$) between CGR and seed yield was indicated in this study (Fig. 3), as also observed by Mondal and Fattah (1997) in rapeseed.

The plots treated with NPK fertilizers plus soil application of B and foliar application of Mo (T₄ treatment) showed higher LAI (5.28) at 90 DAS, although not statistically different from the other treatments, except the control treatment (2.98) which registered the significantly lowest LAI (Table 2). The relationship between LAI and seed yield of lentil was positive and linear ($R^2 = 0.99$) (Fig. 4). Similar relationship was also obtained by Motior *et al.* (1997). The plant height recorded at 75 DAS did not vary much between the treatments consisting of both macro and micronutrients (Table 2). The control treatment produced the shortest plants (32.8 cm). The T₄ treatment produced maximum number of pods/plant (48), followed by T₃ (43) and T₅ (41) treatments. The number of nodules/plant showed notable variation among the treatments. The T₄ treatment (23) was responsible for maximum number of nodule / plant (23) but was not statistically different from the T₃ treatment (18). Application of B and Mo either singly or in mixture enhanced the production of nodules than the exclusive NPK fertilizer treatment (T₂) but the increases were marginal. Foliar application of Mo (T₇ treatment) was slightly better than soil application (T₆ treatment) in increasing the nodule number/plant. The nodule dry weight/plant ranged from 123 mg (control), to 218 mg (T₄) (Table 2). Soil application of NPK+B+Mo (T₃ treatment) showed statistically higher nodule dry weight/plant as compared to the exclusive NPK fertilizers treatment (T₂). The 1000-seeds weight was not affected much by the treatments. The application of NPK fertilizers (T₂) increased the lentil seed yield by 32 % over the control treatment. On an average, the NPK+ micronutrients application treatments (T₃,

T₄, T₅, T₆ & T₇) manifested 61 and 21% increase in seed yield over control and NPK fertilizer treatments respectively. These might be due to enhanced the photosynthesis process and translocation of photosynthetic products to the seeds as a result of increased enzymatic and other biological activities, as also indicated by Zeidan *et al.* (2006). The seed yield in plots lacking in one of the micronutrients (T₅, T₆ and T₇ treatments) showed losses, while not statistically different from the treatments T₃ and T₄ where both B and Mo were applied. On the other hand, when Mo was either applied as foliar along with soil application of B or applied singly to soil, the increase in seed yield was marginal. The results are in harmony with the work conducted by Okaz *et al.* (1994). Sharief and Said (1998) found that foliar application with micronutrients either separately or in mixture significantly increased the seed yield of lentil. Yang *et al.* (2009) reported that application of B fertilizer to sandy soil increased the seed yield by 46% compared to control. The combined application of B with Mo or Zn resulted in higher seed yield than their single applications.

The results of the present experiments suggested that micronutrient application along with macronutrients could prove advantageous in increasing the seed yield of lentil in the resource poor soils of the dry land lateritic tracts.

REFERENCES

- Brown R.H. 1984. Physiological basis of crop growth and development. *In: Growth of Green Plants* (Eds. Teaser, M.B.), Madison, Wisconsin, pp 153-73.
- Fageria, N.K., Baligar, C. and Clark, R.B. 2002. Micronutrients in crop production. *Adv. Agron.* **77**: 185-68.
- Karim, F. and Fattah, Q.A. 2007. Growth analysis of chickpea as affected by foliar spray of growth regulators. *Bangladesh J. Bot.*, **36**: 105-10.
- Mondal, M.R.I. and Fattah, Q.A. 1997. Effect of growth regulators on some physiological parameters of rapeseed. *Dhaka Univ. J. Biol. Sci.*, **6**: 49-55.
- Motior, M.R., Wan Mohammed, W.O., Wong, K.C. and Shamsuddin, Z.H. 1997. Growth analysis and seed yield of winged bean under various support systems. *Thai J. Agri. Sci.*, **30**: 289-98.
- Okaz, A.M.A., El-Garieb, E.A., Kadry, W. and Zahran, F.A.F. 1994. Micronutrient application to lentil plants grown on newly

- reclaimed sandy soils. *Proc. 6th Conf. Agron.*, Al-Azhar Univ., Cairo, Egypt, Sept, 2: 737-52.
- Sharief, A.E. and Said-El. M. 1998. Response of lentil productivity to phosphorous fertilizer levels and some micronutrients. *Proc. 8th Conf. Agron.*, Suez Canal Univ., Ismailia, Egypt, 28-29, November, pp 326-34.
- Singh, A.L. 2001. Yield losses in groundnut due to micronutrient deficiencies in calcareous soils of India. In: *Plant nutrition – Food security and sustainability of agro-ecosystems.* (eds. Horst, N.J., Schenk, M.K., Buerkert et al.), Kluwer Academic Publishers, Netherlands, pp 838-39.
- Yang, M., Shi, L., Xu, F.S., Lu, J.W. and Wang, Y.H. 2009. Effects of B, Mo, Zn and their interactions on seed yield of rapeseed. *Pedosphere*, 19: 53-59.
- Yanni, Y.G. 1992. Performance of chickpea, lentil and lupin nodulated with indigenous micropartners under N, B, Co and Mo fertilization schedules. *World J. Microbiol. and Tech.*, 8: 607-13.
- Zeidan, M.S., Hozayn, M. and Abd El-Salam, M.E.E. 2006. Yield and quality of lentil as affected by micronutrient deficiencies in sandy soils. *J. App. Sci. Res.*, 2: 1342-45.

Table 1 : Physico-chemical properties of the experimental soil

Properties	Value
Sand (%)	62
Silt (%)	24
Clay (%)	24
pH	5.2
Organic carbon (%)	0.62
Total N (%)	0.48
Available P (kg/ha)	12
Available K (kg/ha)	212
B (ppm)	0.46
Mo (ppm)	0.18

Table 2 : Effect of different treatments on growth parameters and seed yield of lentil.

Treatment	Plant height (cm)	Leaf area index (90 DAS)	Pods/plant	Nodule no./plant	Nodule Dry weight/plant (mg)	1000-Seed weight (g)	Seed yield (q/ha)
T ₁	32.8 b	2.98 b	21 c	6 d	123 e	21.6 a	7.4 c
T ₂	37.2 a	3.87 a	35 b	10 cd	172 d	23.4 a	9.8 b
T ₃	39.7 a	4.93 a	43 ab	18 ab	202 b	23.8 a	12.4 ab
T ₄	40.8 a	5.28 a	48 a	23 a	218 a	24.7 a	13.6 a
T ₅	38.2 a	4.75 a	41 ab	16 bc	193 bc	23.5 a	11.8 ab
T ₆	37.5 a	4.13 a	37 b	12 c	184 cd	22.7 a	10.7 ab
T ₇	38.2 a	4.32 a	39 b	14 bc	195 bc	22.1 a	11.1 ab

Note: Values followed by the same alphabet in a vertical column do not differ significantly at 5% level.

T₁: control (no input); T₂: 20:40:20 kg/ha NPK, T₃: T₂ + B (10 kg/ha borax) + Mo (1.5 kg/ha);
 T₄: T₂ + B (10 kg/ha) + Mo (0.2% as foliar at 45 and 65 DAS); T₅: T₂ + B (10 kg/ha);
 T₆: T₂ + Mo (1.5 kg/ha); and T₇: T₂ + Mo (0.2% as foliar at 45 and 65 DAS)

Fig 1 : Above ground dry matter production of lentil at different growth stages as affected by B and Mo application

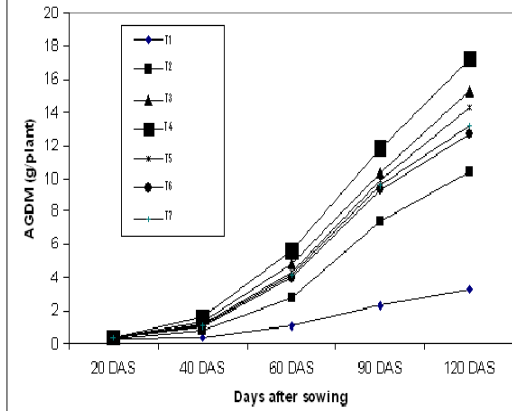


Fig 2: Crop growth rate of lentil as affected by B and Mo application

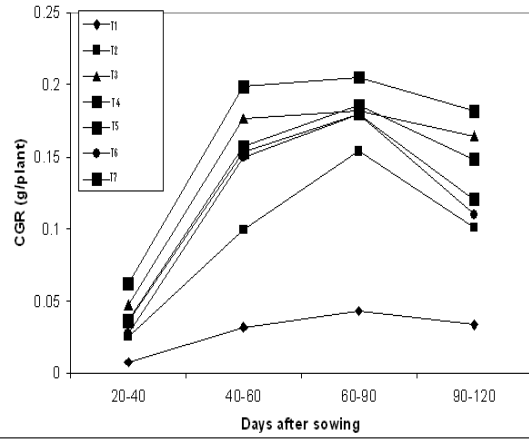


Fig 3 : Relationship between crop growth rate and seed yield of lentil

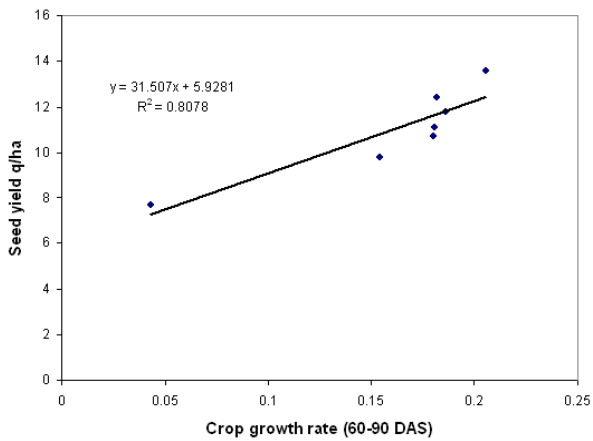


Fig 4 Relationship between leaf area index and seed yield of lentil

